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BRUCE NGS "B", RB #5
IN-SERVICE INSPECTION OF
CONCRETE CONTAINMENT BOUNDARY

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ABSTRACT

An inspection of the containment concrete boundary of Reactor Building 5 (RB#5) was conducted during a planned outage.

No significant defects were noted.

job	file	date	report no.
42-109-453	842.5 BRU B	December 17, 1987	87-291-K

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	SCOPE	1
	2.1 Inspection Methods	1
	2.2 Inspection Areas	2
3.0	OBSERVATIONS	2
4.0	CONCLUSIONS	3
TABLE 1 - Bruce NGS "B" - RB#5 Inspection of Containment Boundary Concrete		4
TABLE 2 - Bruce NGS "B" RB#5 Impact Hammer Tests		10
APPENDIX A		30
DISTRIBUTION		last page

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To Mr. J. Hrutka
Structures Engineer
Design & Development Division - Generation

Attention: Mr. Z.M. Beg

BRUCE NGS "B", RB #5
IN-SERVICE INSPECTION OF
CONCRETE CONTAINMENT BOUNDARY

1.0 INTRODUCTION

An inspection of the accessible exterior concrete containment boundary of the reactor building and fuelling machine duct, Unit 5, at Bruce NGS "B" was conducted from September 28 to October 1, 1987, during the unit outage. This inspection was carried out as outlined in the work plan "Bruce NGS B, 1987 Outage, Containment Boundary Inspection Program, Reactor Vault #5", produced by the Civil Design Department[1] and in the memo from G.S. Kellay to Z.M. Beg (Appendix A). The observations and test results from the inspection are summarized in this report.

2.0 SCOPE

2.1 Inspection Methods

The concrete at selected locations on the accessible exterior containment boundary of the reactor building and fuelling machine duct for Unit 5 was visually inspected. Cracks in the concrete were mapped and the crack widths were measured. Where significant cracks were noted, impact hammer readings were taken in the vicinity of the crack and the crack depth was estimated using ultrasonic test methods. Additional non-destructive testing of the concrete, consisting of impact hammer readings, was conducted at various locations to obtain base readings for future inspections.

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1. Civil Design Department File: 973-NK29-00531 P and 973-NK29-21121 P.

The caulking around embedded parts and at construction joints was visually inspected for obvious deterioration or damage. The concrete surrounding embedded parts was also visually examined for obvious deterioration or damage.

2.2 Inspection Areas

The areas that were inspected are itemized below:

1) All critical stress areas (as determined by Civil Design) on the reactor building containment surface (Figure 1).

2) All accessible areas of the breakout panel on the north side of the reactor building.

3) The concrete around Air Locks 2 and 5 (Figure 1).

4) The concrete around the anchorages and the anchor caps for the post-tensioning system of the main girders.

5) The concrete around the embedded parts for the steam generators and primary heat transport pumps.

6) The concrete around the embedded parts for the preheater enclosures.

7) All areas where cracks were detected during the commissioning tests.

8) The accessible concrete on the exterior of the fuelling machine duct, Unit 5.

9) The outer seal of the reactivity deck mechanism.

3.0 OBSERVATIONS

The observations and results of tests conducted during this inspection are summarized in Tables 1 and 2 and in Figures 2 to 25. The results reported in Table 1 are divided into items as given in Section 2.2.

4.0 CONCLUSIONS

In general, the concrete inspected is in good condition and of good quality. A 0.020" wide crack in the south wall of the fuelling machine duct between Units 5 and 6 appears to have been previously repaired. The significance of this crack should be assessed by the Civil Design Department.

Approved by:

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HC/EJM:cm

TABLE 1

BRUCE NGS "B" - RB#5
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
1. All critical stress areas on the reactor building containment surface (Figure 1).	Elevation 615′ Loc 1 - Vertical crack in north wall (width <0.005") - Horizontal crack, Elevation 622′ (width <0.005") Loc 2 - Vertical crack (width = 0.005") Loc 3 - No cracks noted Loc 4 - Vertical crack in north wall (width = 0.005" to 0.010") - No cracks noted in east wall Loc 5 - East wall not accessible - No cracks noted in south wall Loc 6 - Horizontal crack, Elevation 622′ in west wall (width < 0.005") - Diagonal crack in south wall (width = 0.005") Loc 7 - Hairline cracks (width <0.002") Loc 8 - No cracks noted Loc 9 - Vertical cracks extending from EPs (width = 0.010") Elevation 642′ Loc 1 - Horizontal crack, Elevation 650′, in west wall (width = 0.015") Loc 2 - Not accessible Loc 3 - Not accessible Loc 4 - Horizontal crack and vertical cracks, Elevation 650′in north wall (width = 0.010 to 0.015") - Horizontal crack in east wall (width = 0.005")

TABLE 1 continued

BRUCE NGS "B" - RB#5
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
	Loc 5 - South wall not accessible - Horizontal cracks, Elevations 647 and 650', in east wall (width = 0.005") Loc 6 - Horizontal cracks, Elevations 647 and 650' (width = 0.005") Loc 7 - Not accessible Loc 8 - Not accessible Loc 9 - Not accessible Elevation 666' Loc 1 - Horizontal crack, Elevation 670' (width = 0.010") Loc 2 - Hairline cracks (width <0.002") Loc 3 - Hairline cracks (width < 0.002") Loc 4 - Horizontal cracks, Elevation 670' (width 0.010 to 0.015"); localized deterioration of caulking, see Figures 2 and 3. Loc 5 - Hairline cracks in east side - South wall not accessible Loc 6 - Horizontal cracks, west wall (width 0.010") - South wall not accessible Loc 7 - Horizontal hairline cracks (width <0.002") Loc 8 - Horizontal hairline cracks (width <0.002") Loc 9 - Vertical hairline cracks (width <0.002")
2. All accessible areas of the breakout panel on the north side of the reactor building (Figure 4)	- Location of the cracks noted on the breakout panel are shown in Figure 4. All cracks were less than 0.005" wide. - Area between Elevations 639 and 662' was not accessible.

TABLE 1 continued

BRUCE NGS "B" - RB#3
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
3. The concrete around Air Locks 2 and 5 (Figure 1).	Air Lock 2 - Cracks extend from the upper portion of the airlock (width <0.005"). See Figure 5. Air Lock 5 - No cracks noted. See Figure 6.
4. The concrete around the anchorages for the post-tensioning system of the main girders.	Elevation 704' East girder, north end - Cracks noted (width = 0.002 to 0.005"). See Figures 7 and 8. East girder, south end - Access restricted, no cracks noted West girder, south end - Access restricted, crack extends from anchor cap (width approx. 0.010") West girder, north end - Cracks noted (width approx. (0.010") Elevation 670' East girder, north end - Cracks noted (width = 0.010") East girder, south end - Cracks noted (width = 0.010"); east side not accessible. See Figure 9. West girder, south end - Cracks noted (width = 0.010"); west side not accessible. West girder, north end - Cracks noted (width = 0.005") Grouted tendons - no rust stains or deterioration of the anchor caps was noted. Greased tendons - no rust stains, leakage of grease or deterioration of the anchor caps was noted. As there was no evidence of corrosion or leakage of grease, the caps were not removed.

TABLE 1 continued

BRUCE NGS "B" - RB#5
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
5. The concrete around the embedded parts for the steam generators and primary heat transport pumps	- Hairline cracks (width <0.002") noted in concrete around steam generators and primary heat pumps - All Dywidag nuts for the primary heat pumps are hand tight - Cracks (width = 0.010") noted in sides and in top surface of transverse girder - See Figures 10 and 11.
6. The concrete around the embedded parts for the preheater enclosures	- The location of cracks in the concrete around the preheater enclosures are shown. All cracks were less than 0.005" wide. See Figures 12 to 16. - On the east wall of the west boiler room, three EPs were observed to be rusted. Two of these were: EP 11320 and EP 11321. See Figures 17 and 18.
7. All areas where cracks were detected during the commissioning tests. (Cracks noted during commissioning are shown in Report NK29-21121-5 which contains drawings NK29-DOH-21146-2006,-2007,-2009 and -2011)	- All cracks reported during commissioning were located and any additional cracks reported. Figures 19 to 22 show the location of cracks noted during the inspection.

TABLE 1 continued

BRUCE NGS "B" - RB#5
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
8. The accessible concrete on the exterior containment boundary of the fuelling machine duct	- Only the south wall of the fuelling machine duct is accessible. Elevation 579' - Hairline cracks (width <0.002") noted in wall - On the east side of the construction joint between Units 5 and 6, a crack is present from Elevation 583 to 591' (width = 0.020"). The concrete adjacent to the joint is spalling and the caulking is separating from the concrete. Injection ports in the concrete indicate the concrete was previously repaired in this area. Ultrasonic measurements taken across the crack, to estimate the crack depth, gave poor results because of the proximity of the crack to the construction joint. See Figures 23 and 24. Elevation 591' - Hairline cracks (width <0.002") noted in wall. - Spalling of concrete and separation of caulking noted along construction joint between Units 5 and 6 from Elevation 591' to 615'. See Figure 25. - Caulking deteriorating around EP at approx. Elevation 605' between Cols 5Mx and 5N.

TABLE 1 continued

BRUCE NGS "B" - RB#5
INSPECTION OF CONTAINMENT BOUNDARY CONCRETE

LOCATION	OBSERVATIONS
	Impact hammer test results:

Location	Impact Hammer Reading	Relative Strength (psi)
Elevation 583′, west of construction joint between Units 5 and 6	47.9	6200
Elevation 583′, east of construction joint between Units 5 and 6 (spalled area)	42.0	5400
Elevation 583′, east of construction joint near Col 9I 5N	46.8	6500
Elevation 595′, east of construction joint near Col 9I 5P	41.1	5200

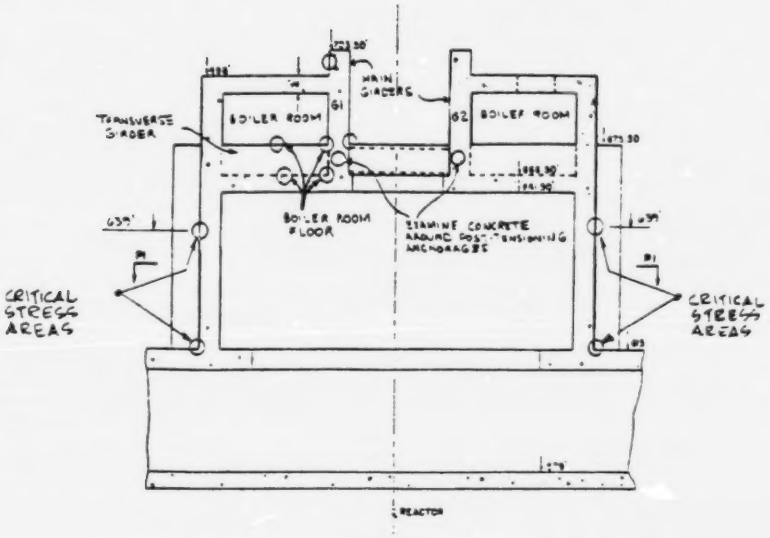
9. The outer seal of the reactivity deck mechanism.	The seal was not accessible during this inspection. However, it was inspected by the Civil Design Department at a later date.

TABLE 2

BRUCE NGS "B" #RB 5
IMPACT HAMMER TESTS

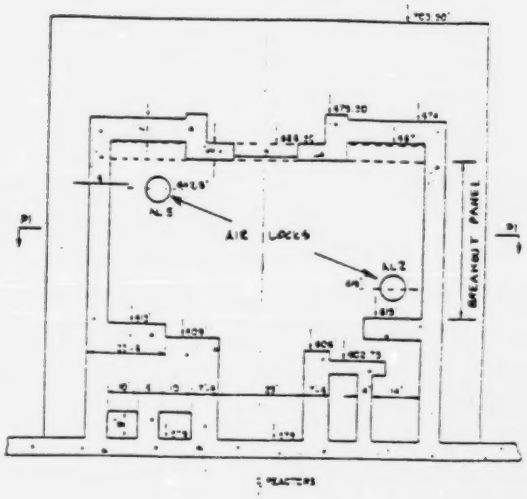
Location	Reference Figure	Impact Hammer Reading	Relative Strength (psi)
IH 1	21	45.9	6300
IH 2	22	45.6	6200
IH 3	22	48.9	7000
IH 4	19	48.2	6800
IH 5	19	48.6	6900
IH 6	19	49.7	7200

Note: The Locations (IH 1 to 6) where impact hammer tests were performed are shown on the Figures 19, 21 and 22.



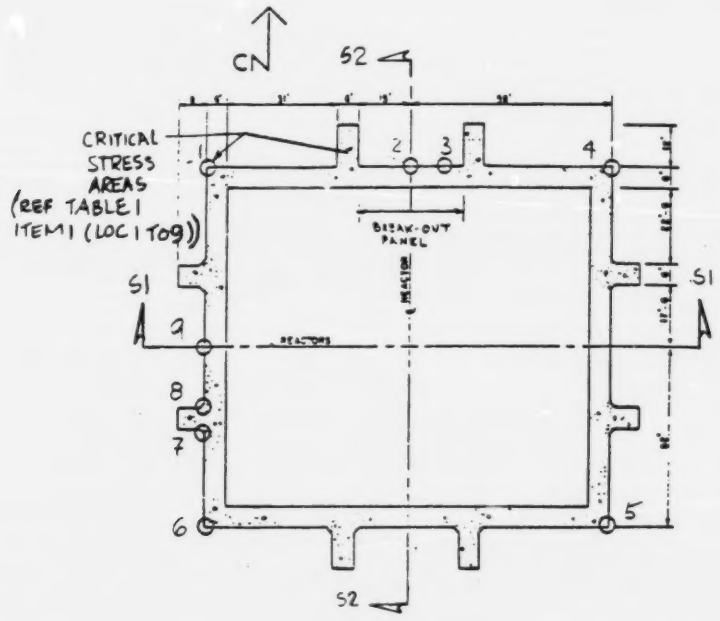
SECTION S1

CRITICAL STRESS AREAS ARE SHOWN BY ○



SECTION S2

CRITICAL STRESS AREAS ARE AROUND AIR LOCKS



PLAN VIEW
REACTOR BUILDING

CRITICAL STRESS AREAS ARE SHOWN BY ○

FIGURE 1
BRUCE NGS 'B', RB#5
INSPECTION LOCATIONS

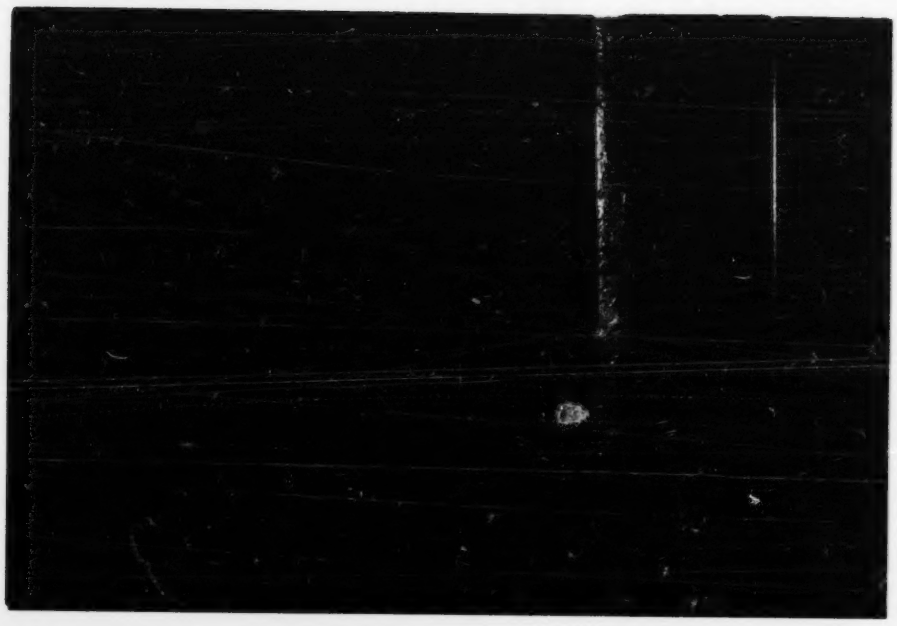


FIGURE 2. Critical Stress Area 4 (See Figure 1). Elevation 666'
Crack (width = 0.010 to 0.015") in the northeast corner of the reactor building

FIGURE 3. Critical Stress Area 4 (See Figure 1).
Elevation 666'. Localized deterioration of the surface of
the caulking on the northeast corner of the reactor building

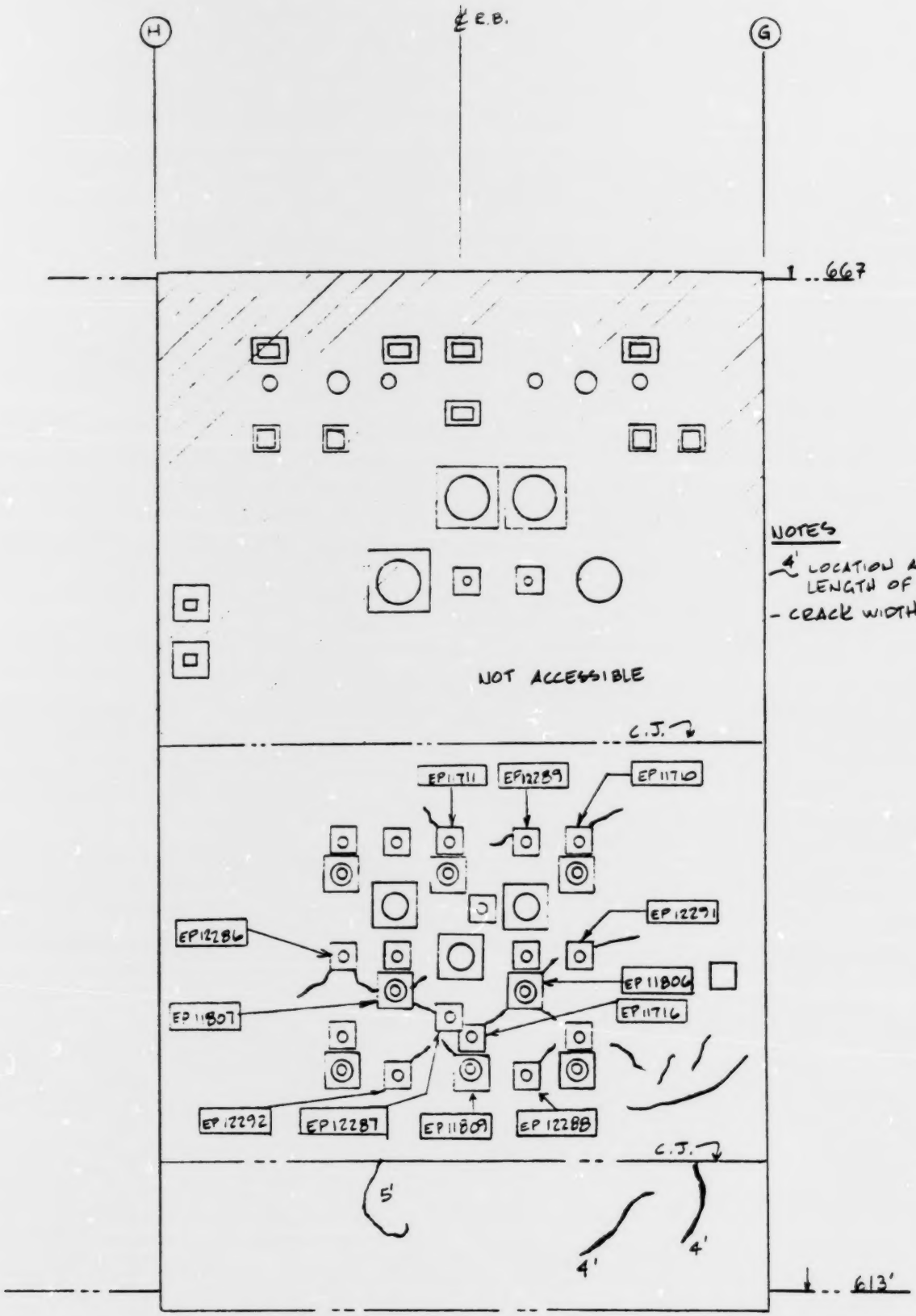


FIGURE 4
BRUCE NGS 'B', RB#5
BREAKOUT PANEL

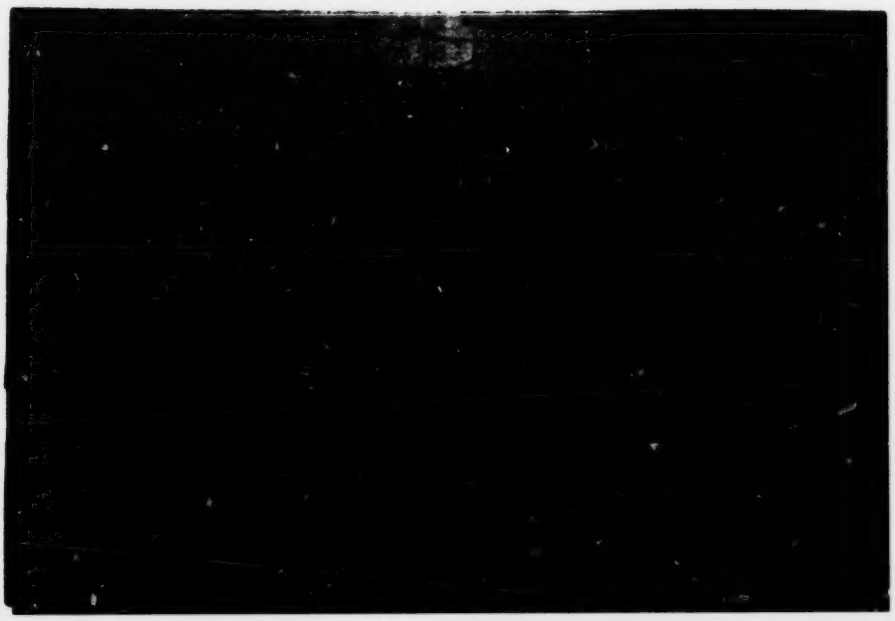


FIGURE 5. Airlock 2
Cracks (width = 0.005") extend from Air Lock 2

FIGURE 6. Air Lock 5. No cracking was noted around Air Lock 5

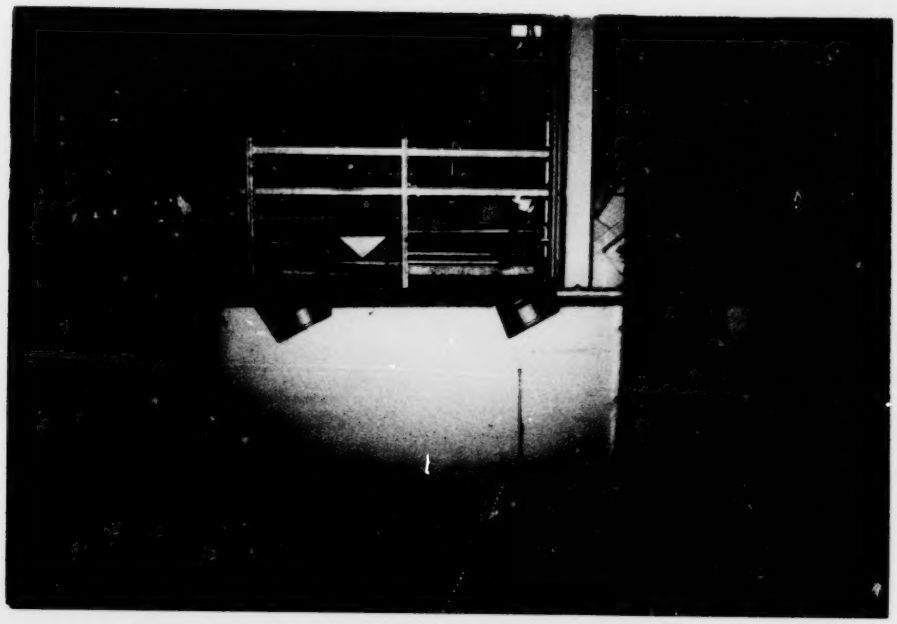


FIGURE 7. East girder, north end, Elevation 704'.
No rusting of anchor caps or significant cracking of concrete was noted

FIGURE 8. Anchor caps, east girder, north end, Elevation 704'.
No rusting of anchor caps or significant deterioration of concrete was noted

FIGURE 9. Anchor caps, east girder, south end, Elevation 670'.
No rusting of anchor caps or significant cracking of concrete was noted

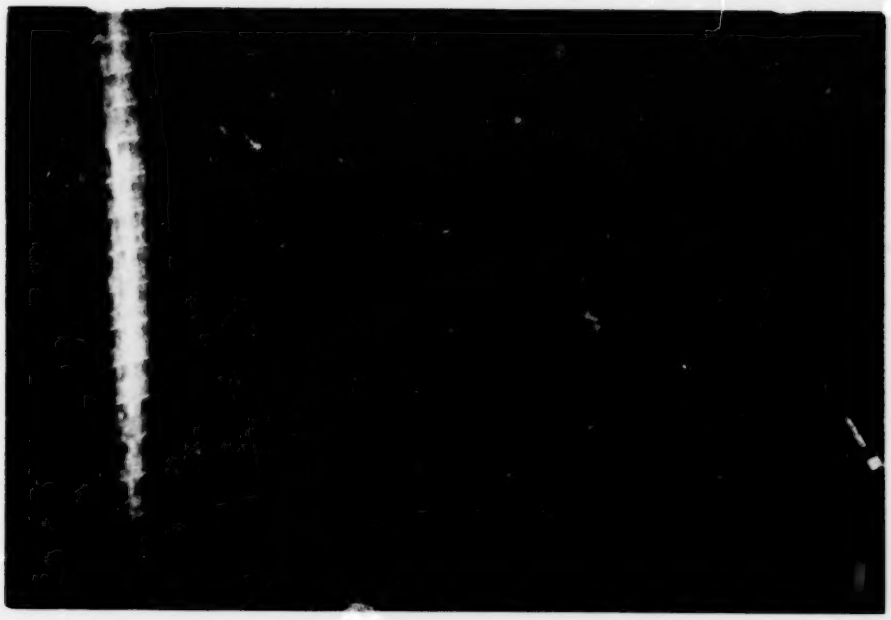


FIGURE 10. South transverse girder, south side.
Cracks (width = 0.020") were noted in the top of the transverse girder

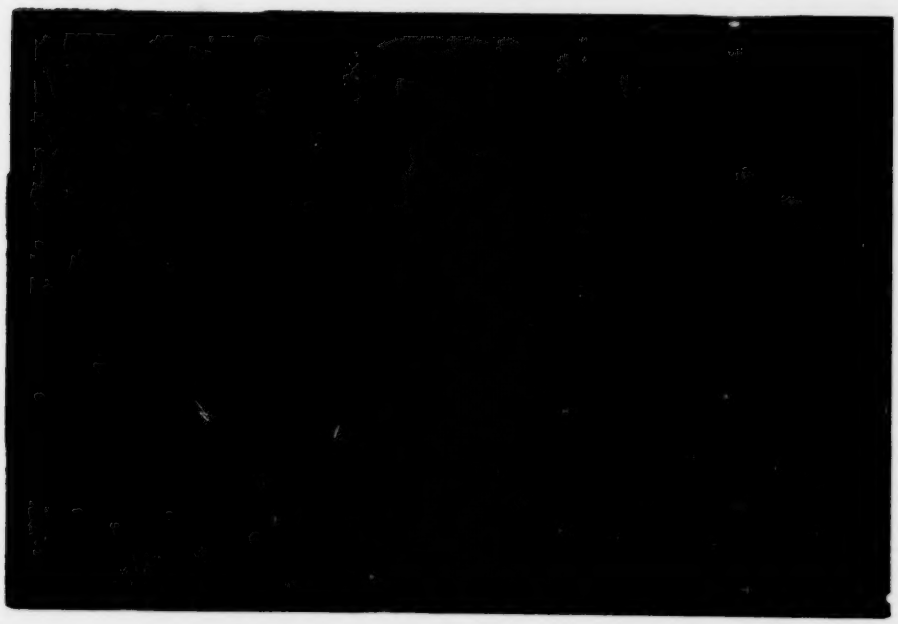
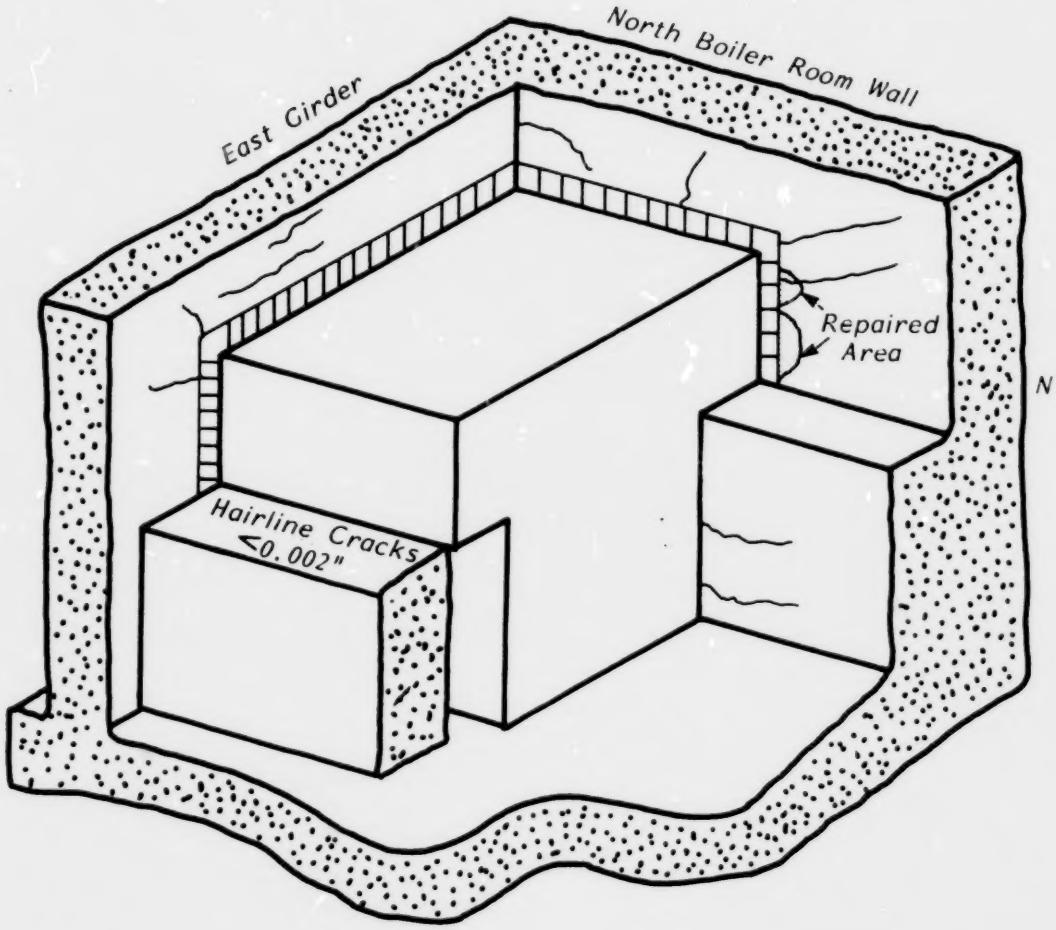
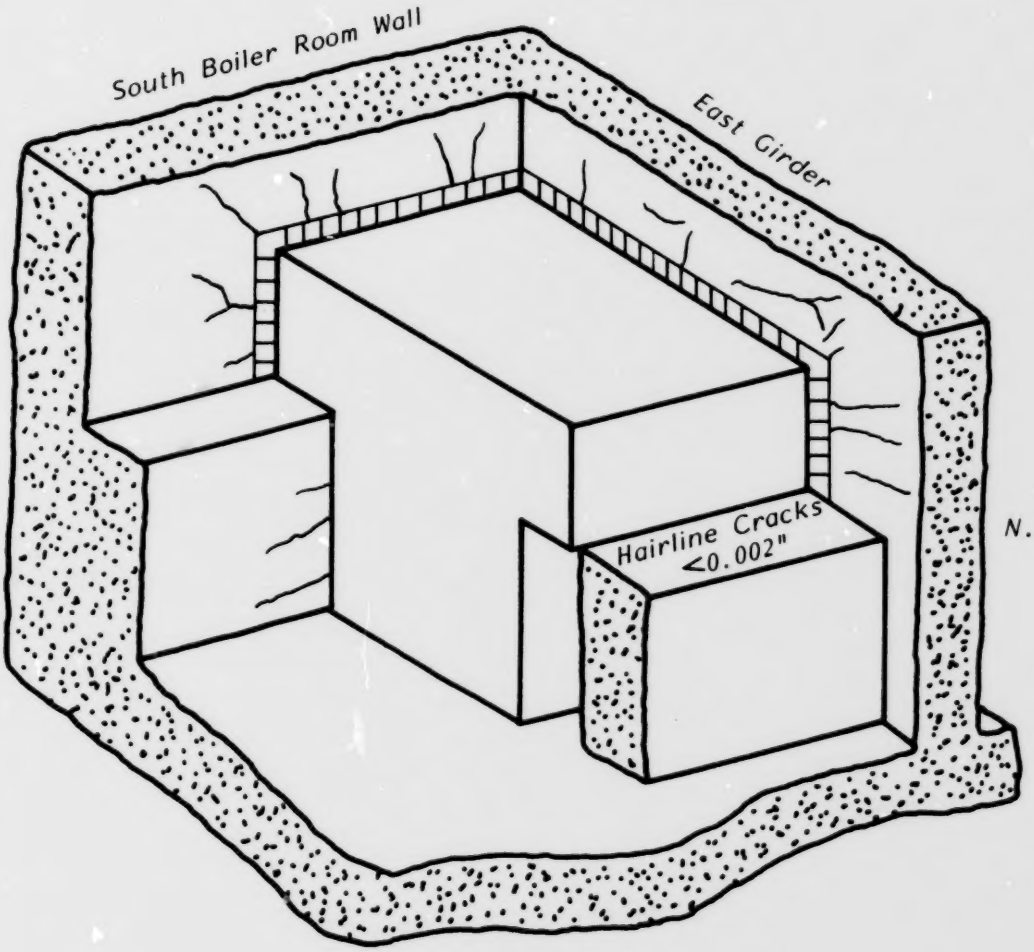


FIGURE 11. Concrete floor near the heat transport pumps.
Typical cracks noted in the floor.



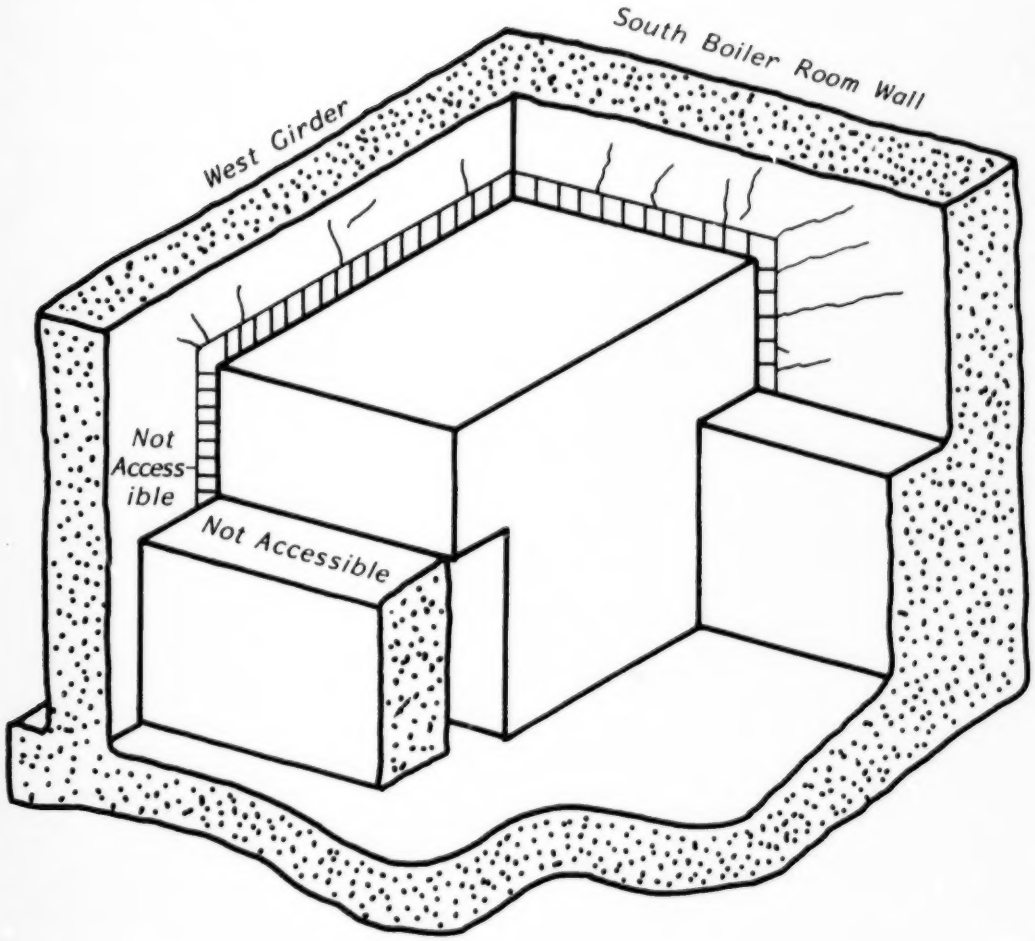
General Notes: *Crack width <0.005" unless otherwise noted.*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 12
UNIT 5 - NORTHEAST PREHEATER ENCLOSURE CONCRETE INSPECTION



General Notes: *Crack width <0.005" unless otherwise noted.*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

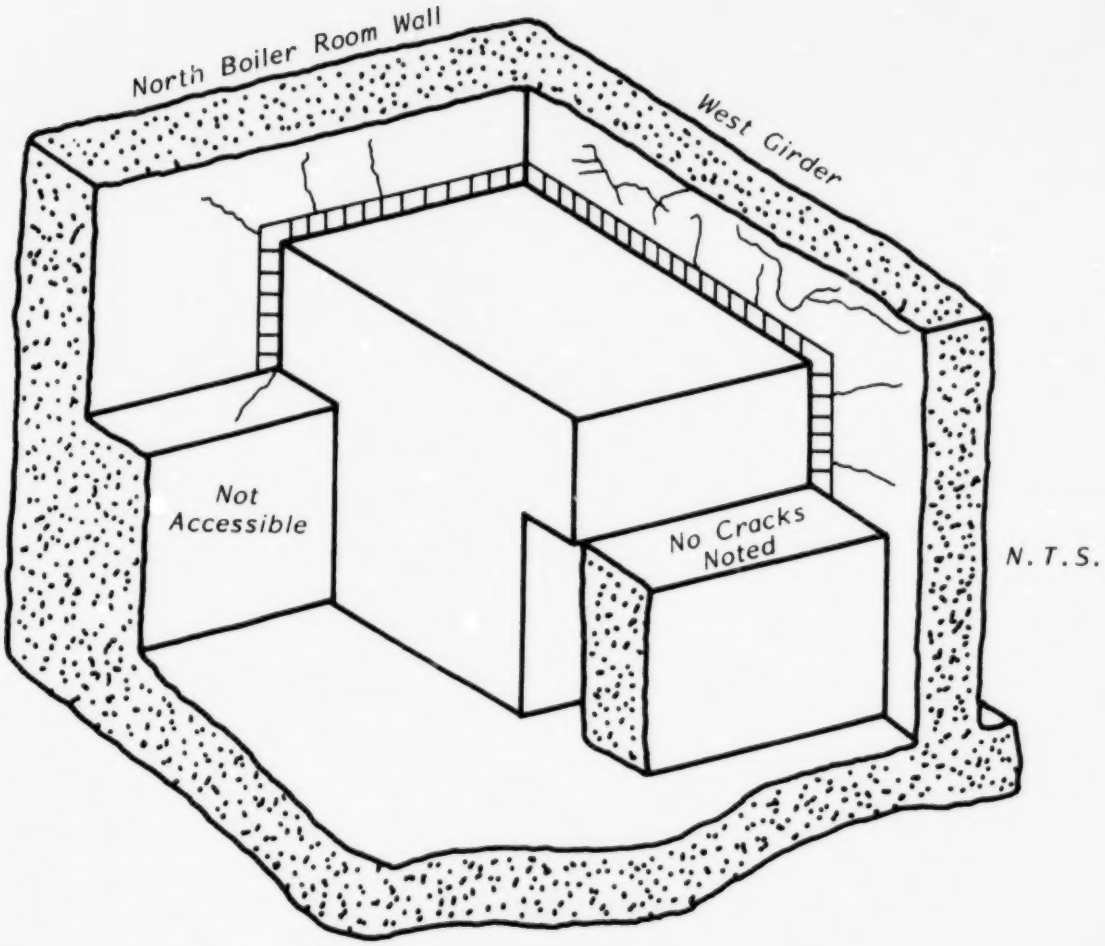
FIGURE 13
UNIT 5 - SOUTHEAST PREHEATER ENCLOSURE CONCRETE INSPECTION



General Notes: *Crack width <0.005".*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 14

UNIT 5 - SOUTHWEST PREHEATER ENCLOSURE
CONCRETE INSPECTION



General Notes: *Crack width <0.005".*
No signs of concrete deterioration.
Polysulphide sealant between steel enclosure and concrete intact with no signs of deterioration.

FIGURE 15
UNIT 5 - NORTHWEST PREHEATER ENCLOSURE
CONCRETE INSPECTION

FIGURE 16. Southeast Preheater Enclosure.
A typical crack (width < 0.005") extending from the side of the preheater enclosure in the west wall of the east boiler room.

FIGURE 17. EP11320 and EP11321 in east wall of west boiler room. Rusting of EPs observed.

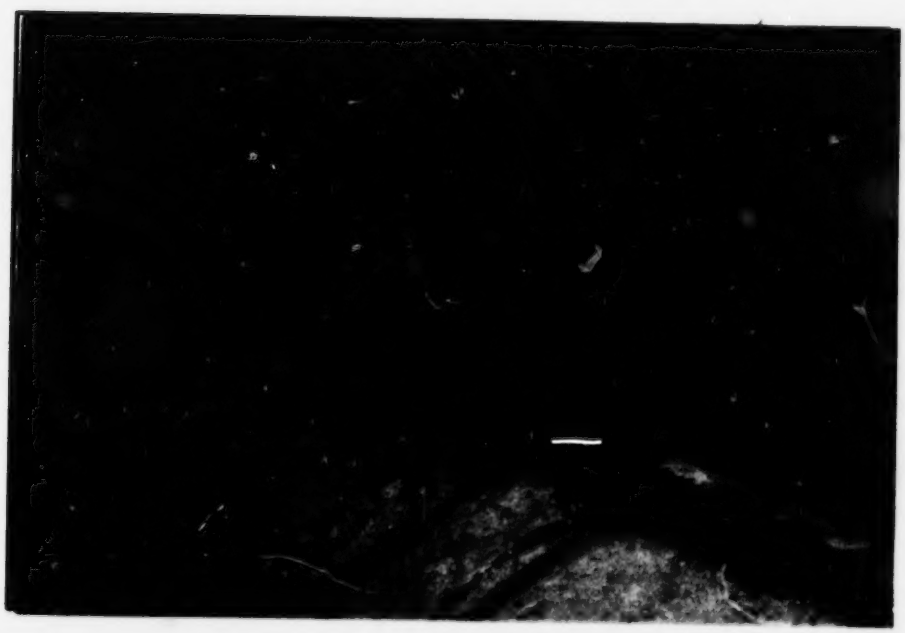
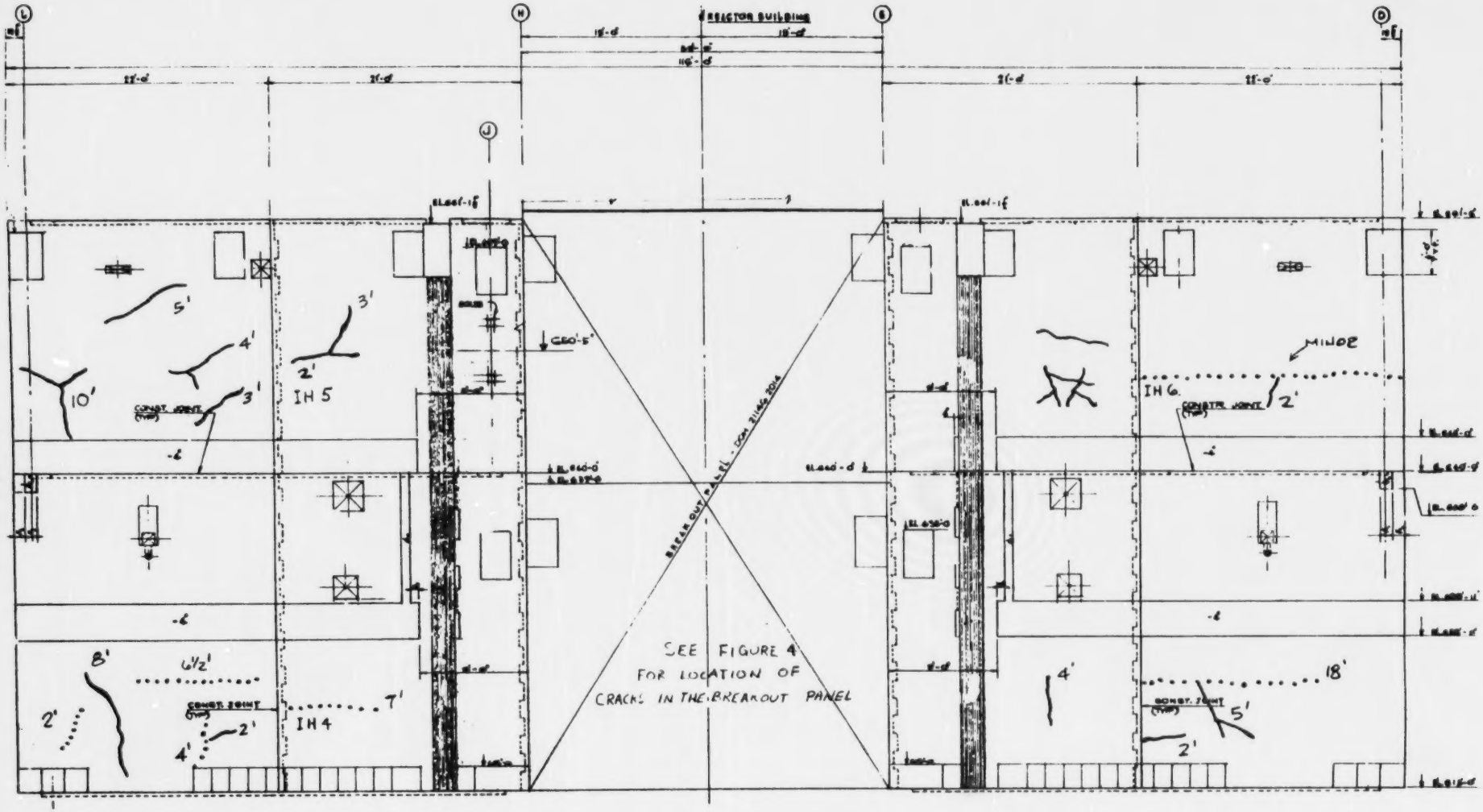


FIGURE 18. EP in east wall of west boiler room. This EP is connected to the same pipe as EP11321 (Figure 17) and is embedded in the same wall.



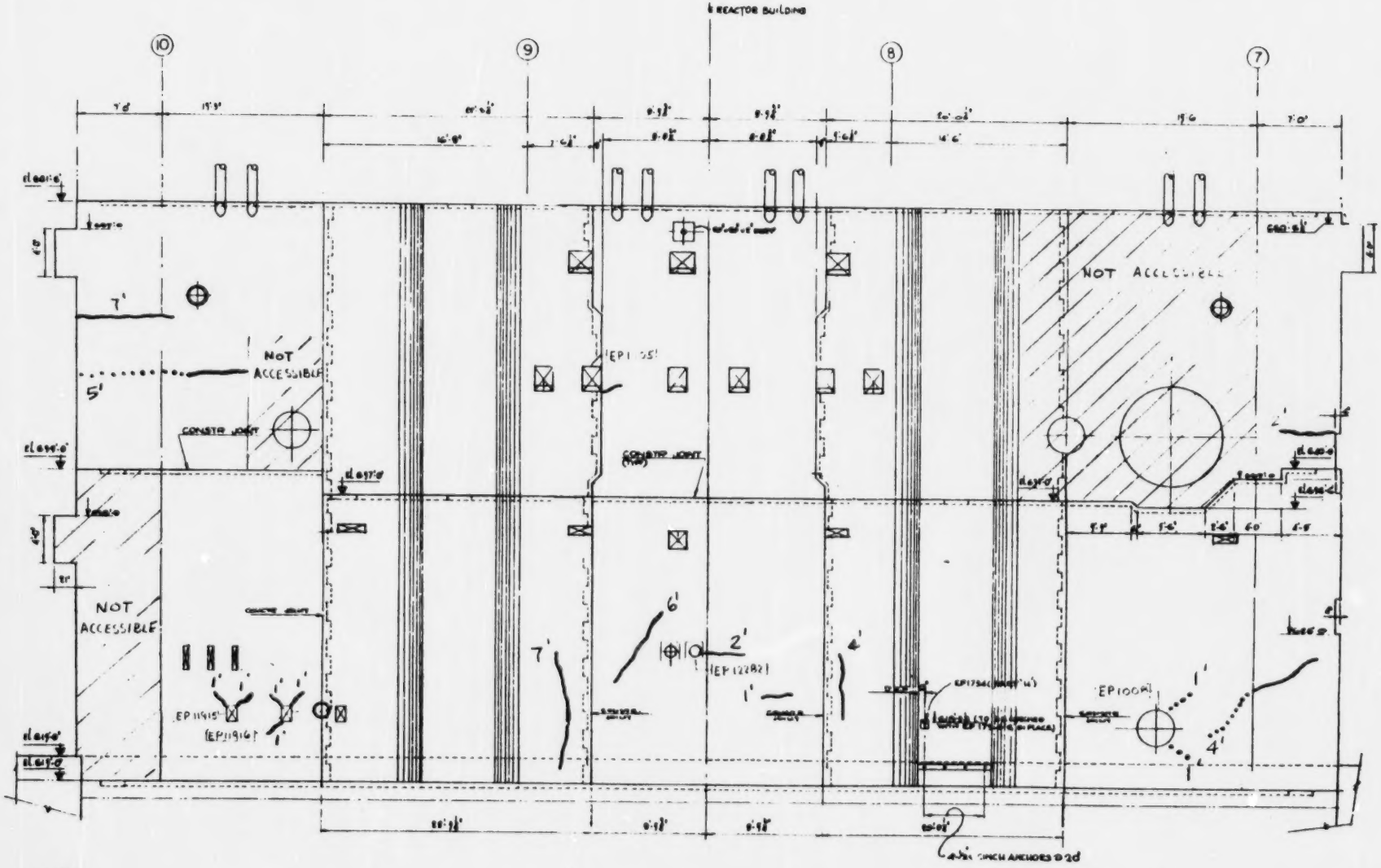
NOTE

5' LOCATION AND APPROX. LENGTH OF CRACKS

2' LOCATION AND APPROX. LENGTH OF CRACKS NOTED DURING COMMISSIONING

- CRACK WIDTH < 0.005"
- IH5 : LOCATION OF IMPACT HAMMER READINGS (SEE TABLE 2)

FIGURE 19
BRUCE NGS 'B', RB#5
REACTOR BUILDING
EXTERIOR NORTH WALL



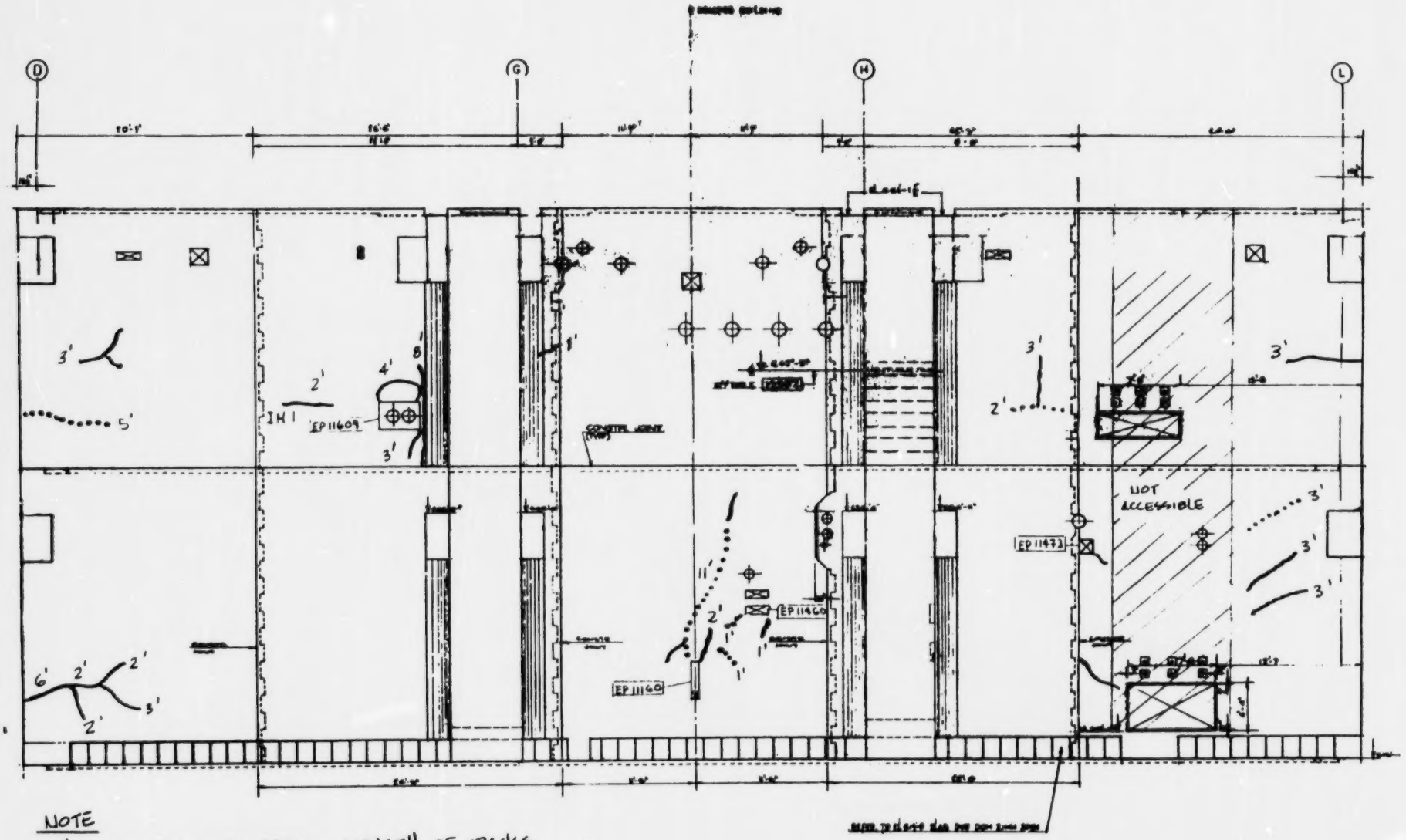
NOTE

5' LOCATION AND APPROX. LENGTH OF CRACKS

2' LOCATION AND APPROX. LENGTH OF CRACKS NOTED DURING COMMISSIONING

- CRACK WIDTH < 0.005"

FIGURE 20
BRUCE NGS 'B', RB#5
REACTOR BUILDING
EXTERIOR EAST WALL



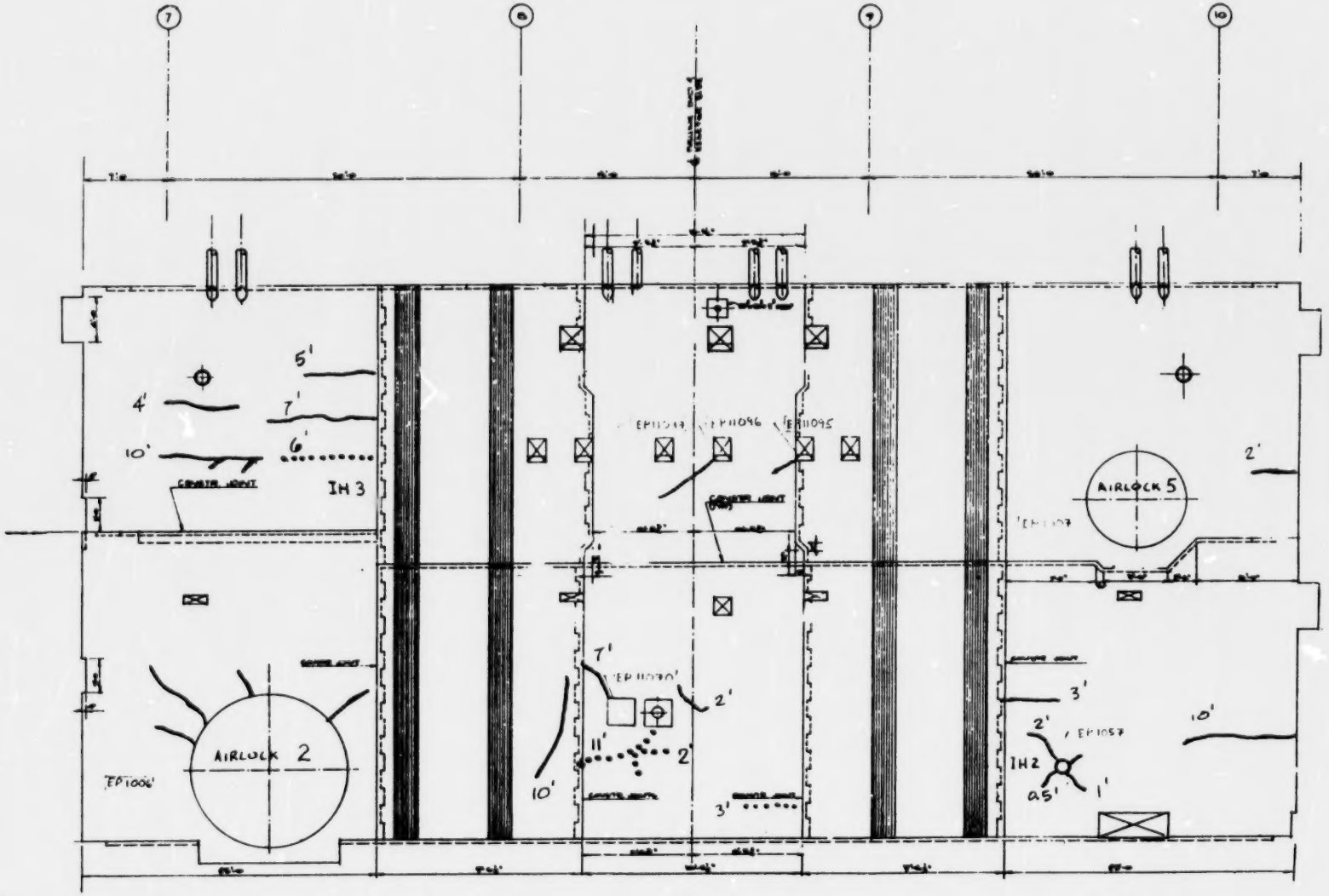
NOTE

5' ~ LOCATION AND APPROX. LENGTH OF CRACKS

..2'... LOCATION AND APPROX. LENGTH OF CRACKS NOTED DURING COMMISSIONING

- CRACK WIDTH < 0.005"
- IH5 : LOCATION OF IMPACT HAMMER READINGS (SEE TABLE 2)

FIGURE 21
BRUCE NGS 'B', RB#5
REACTOR BUILDING
EXTERIOR SOUTH WALL



NOTE

5' ~ LOCATION AND APPROX. LENGTH OF CRACKS

2' ·..·.. LOCATION AND APPROX. LENGTH OF CRACKS NOTED DURING COMMISSIONING

- CRACK WIDTH < 0.005"
- IH5 : LOCATION OF IMPACT HAMMER READINGS (SEE TABLE 2)

FIGURE 22
BRUCE NGS 'B', RB#5
REACTOR BUILDING
EXTERIOR WEST WALL

FIGURE 23. Fuelling machine duct construction joint between Units 5 and 6. Elevation 579'. Cracking (width = 0.020") of concrete and separating of the caulking along the construction joint.

FIGURE 24. Fuelling machine duct construction joint between Units 5 and 6. Elevation 579'. Location of injection ports that may have been used to repair the concrete in this area.

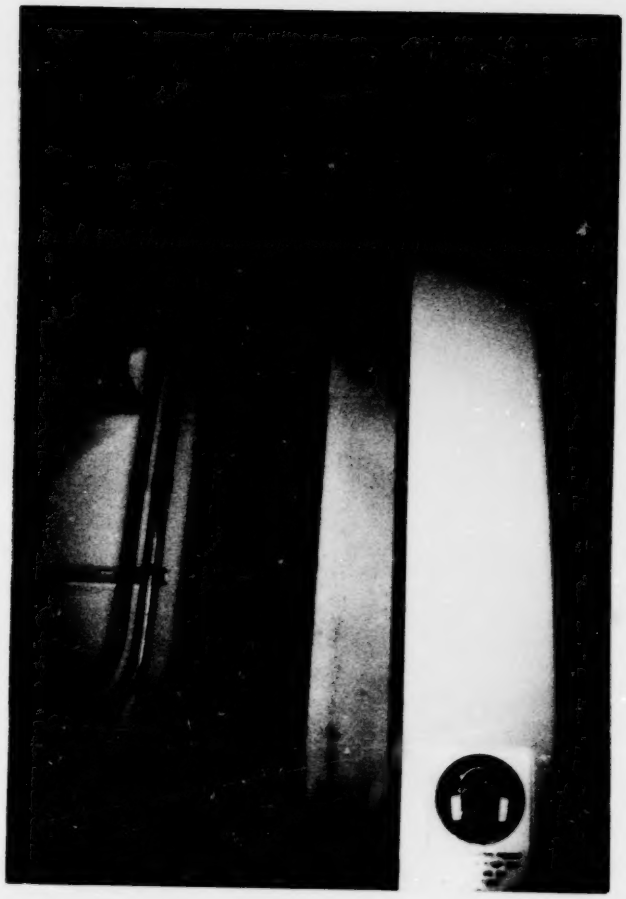


FIGURE 25. Fuelling machine duct construction joint between Units 5 and 6 at Elevation 591'. The scaling of concrete and separating of caulking was not as severe in this area as at Elevation 579'.

APPENDIX A

BRUCE NGS "B", RB #5

IN-SERVICE INSPECTION OF CONCRETE CONTAINMENT BOUNDARY

CORRESPONDENCE BETWEEN CIVIL RESEARCH AND CIVIL DESIGN DEPARTMENTS

Ontario Hydro

Memorandum To MR. Z.M. BEG
Civil Design

Date September 25, 1987

Location or Dept H17F27

File 842.5BRUB

Subject Inspection of Reactor Building No. 5
- Bruce NGS "B"

The following work will be conducted by the Civil Research Department on the accessible external containment boundary of Reactor Vault No. 5 as described in "Bruce NGS "B", 1987 Outage Containment Boundary Inspection Program, Reactor Vault No. 5.

Section A Concrete inspection - The inspection areas identified in Items 1 to 6 will be visually inspected as access permits. Additionally, at the request of Civil Design, all areas of the Fuelling Machine Duct accessible from the outside will be inspected. The non-destructive testing of concrete, Item 7, will only be conducted where necessary. The anchorhead caps for the grouted and ungrouted post tensioning tendons, Items 8 and 9, will be visually inspected for signs of rust and leakage of grease. The need for removal of the caps will be based on this visual inspection and discussions with the Civil Design Department. The physical removal of the caps will be performed by station personnel. The caulking will be visually inspected and any obvious deterioration or damage will be reported.

Section B Reactivity Mechanism Deck Seal - The outer seal will be visually inspected. Access to the outer seal will be provided by Bruce NGS "B" Operations personnel. Civil Research will not inspect welds or metallic parts.

Section C Electrical Penetrations - The concrete around all accessible electrical penetrations will be visually inspected. As well, any obvious damage or deterioration of the penetrations will be reported.

Section D Preheater Enclosures - The concrete as identified in Section A, Item 6, will be inspected. As well, any accessible Dywidag nuts will be visually inspected.

Section E Primary Heat Transport Pumps and Steam Generators Metal Bellows Seal - The concrete as identified in Section A, Item 5, will be inspected.

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Section F Metallic Components and Liners - Civil Research will visually inspect for obvious flaws in the metallic components of the external containment boundary (penetrations, seal plates) which are accessible from the floor.

INFORMATION COPY
ORIGINAL SIGNED BY
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